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A CASE OF GLIOMA OF THE LOWER CERVICAL REGION OF THE SPINAL CORD PRODUCING A TOTAL TRANSVERSE LESION, IN WHICH THERE WAS SPASTICITY OF THE LOWER LIMBS AND PERSISTENCE OF THE DEEP REFLEXES.[1]

I. A STUDY OF THE TUMOR AND SOME OF THE PHENOMENA PRODUCED THEREBY.

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II. A STUDY OF A PECULIAR FORM OF DEGENERATION (DEGENERATIO MICANS) MET WITH IN THIS CASE.

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III. SOME POINTS IN THE PATHOLOGY OF SYRINGOMYELIA.

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I.

The patient, who first came under my charge from August to November, 1890, was a man, aged fifty years, whose family and personal history was free from any record of either syphilis or tuberculosis. Six months previously he had been thrown from a horse, striking on his shoulders and neck, and to that injury he attributed his symptoms, which then consisted chiefly of pain along the spine from the dorsal region downward and burning in the legs and feet. The knee-jerks were exaggerated; he swayed when standing with the eyes closed. He grew slowly worse on mixed specific treatment; passed from my care, and I did not see him for six years. During this time he had repeated "dysenteric" attacks, and early lost power in the legs, these members having become almost entirely helpless in 1891 and, finally, completely so in 1895. By this time sensation had become lost as high as the nipple line. He had never had the excruciating pain common in spinal tumor, but there had been moderate pain along the spine and a well-marked girdle pain. The slightest irritation caused violent spasmodic contractions of the muscles of the legs, these contractions and the burning pain of which he complained being increased by the use of strychnine. When seen in December, 1896, his stomach was very unretentive, vomiting having begun some time before after indiscretion in diet.

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[1] On account of the length of the original contribution it was considered advisable to publish it in this Journal in abstract.

The paper has been published in full in the form of a monograph, which will be sent to those interested in the subject, upon request to Dr. W. H. Hudson, La Fayette, Ala.

At this time he was dyspnœic, and his breathing was entirely diaphragmatic. He was generally free from suffering, but rotation of the head caused pain in the right arm and neck. His pupils were small and reacted imperfectly. Sensation in all parts was lost below the third rib in front and the spine of the scapula behind. Above this there was some hyperæsthesia. The legs were rigid and entirely paralyzed. Muscular atrophy had not occurred except in the interossei of the hand, and there were no destructive trophic changes.

The skin reflex was present in the legs and feet; there was violent ankle clonus and some exaggeration of the knee-jerks. The cremasteric and epigastric reflexes were lost. There was neither rigidity nor deformity of the spine.

An intradural tumor was believed to be present, and this was thought to be probably intramedullary. The thought of operation was entertained, but the patient died within a few weeks and before it was possible to operate.

I was allowed to remove the spinal cord in part only, but obtained the portion reaching from the level of the fourth cervical to that of the third dorsal vertebra. The upper five centimetres of this consisted chiefly of a tumor reaching nearly throughout the whole lateral extent of the cord and ending above and below in two cone-like projections, one of these being continued downward in the form of a central stem of what appeared to be gliomatosis. This stem was surrounded by softened cord. The general form of the tumor and of the stem of gliomatosis and the cavities in the mass seen upon making a series of sections are well shown in Plate I. Microscopical examination showed that the tumor formation involved nearly the whole cord—a mere rim of nerve-fibres surrounding it, and these showed marked degeneration posteriorly and a lesser amount anteriorly. Some ganglion cells remained, chiefly in the anterior horns; most of them, however, were degenerated. The tumor consisted of a very large number of much thickened bloodvessels, many of which showed hyaline degeneration, fibres, and of cells which were round, oval, or pyriform in shape. They were somewhat irregularly arranged, but often appeared to radiate from the bloodvessels. These appearances are more fully discussed by Dr. Flexner. In many places there were blood extravasations. The stem of gliomatosis contained large numbers of the peculiar bodies, which will be more completely described by Dr. Barker. Smaller numbers of them were found in the tumor mass also, and I believe it is probable that they play a part in the formation of the cavities, owing to the degeneration which is going on in them, though some of the cavities appear to be the result of extravasations, and, perhaps, of the obliteration of many small bloodvessels.

The curious bodies mentioned often resembled ganglion cells, and are likely to be mistaken for them, and I believe this was done in the case reported by Turner and Mackintosh,[1] in which they believed that they found ganglion cells in an area similar to the central gliomatosis in my case. I believe from my study of them that some of them were degenerated bloodvessels, and others probably degenerating glia-fibres (in the sense of Weigert); but most of them appeared to be degenerated bipolar cells. I think that in their nature the bodies are entirely similar to those found by W. Rosenthal[2] in a neuro-epithelioma of the spinal cord. He believes that they are degenerated glia-fibres (in the sense of Weigert), but in a letter to me states that he believes the bodies observed by each of us are quite similar.

This case came under my care for advice as to the propriety of operation, and had the patient's general condition allowed of it I would have operated. Surgery alone offers the only hope of relief in cases of spinal tumor, and although intramedullary tumors are incurable, even by surgical methods, I believe that in case there is any doubt as to whether the tumor is within the substance of the cord the rule should be to operate, and even when the mass is certainly intramedullary I see no reason why an operation undertaken purely for the purpose of relieving pressure would not be quite as justifiable as in cases of cerebral neoplasm, and I believe the result would be relief of suffering and prolongation of life. As to the reflexes: Undoubtedly from the appearance of the tumor and of the softened cord below there was a complete transverse division of the cord, and this certainly occurred some time previous to the man's death. Until very recently it has been thought that a total transverse lesion of the cord above the lumbar enlargement always produced increase of the deep reflexes and spasticity of the legs if the lumbar enlargement was healthy. Gowers, in a recent personal communication, states that he still holds to this opinion, and believes that in those cases in which the reflexes are lost there has been enough excitation to interfere with the function of the cells in the lumbar enlargement.

On the contrary, Bastian and Hughlings-Jackson believe that the cerebellum has an enforcing influence on the reflexes, and that if all connection with the brain is cut off the reflexes are permanently and entirely abolished. There has been much discussion of the question.

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[1] Brain, 1896, Parts II. and III.

[2] Ziegler's Beiträge, 1898, Band xxxiii., Heft 1.

Gerhardt[1] has published a case which he believes destroys the view of Bastian, while Bruns[2] has offered the record of the most reliable case that showed loss of reflexes without demonstrable disease of the lumbar enlargement or adequate changes in the nerves or muscles. I believe that my case is conclusive proof that the reflexes may remain when the cord is completely severed, if the lumbar enlargement is healthy, for in this case there was slow progress without sufficient irritation or circulatory disturbance to cause lumbar changes.

In a case to be published in the future I have observed very extensive destruction of the cerebellum by a cyst, and in this case the reflexes returned soon after evacuation of the cyst and before the patient showed any indication of resumption of the cerebellar functions. I believe, therefore, that we may conclude: That the cord may be intact and degeneration in the lumbar enlargement, nerves, and muscles absent, and yet the reflexes may be lost; that the cerebellum in the human subject may be largely destroyed and wholly inactive functionally, and yet the reflexes may persist; that the spinal cord may be entirely severed in the upper dorsal region, and spasticity of the limbs and preservation of the reflexes may still be noted; that the rigidity of the paralyzed limbs is not due to the "unrestrained" (Bastian) or "unantagonized" (Hughlings-Jackson) influence of the cerebellum passing downward to the spinal cord; that the spinal cord is the centre of the deep reflexes, and also has within itself the power of producing spasticity.

It would seem that shock from injury and severe disease may destroy for all time the power which produces the reflexes, and that the loss of the deep reflexes is produced by further causes than the total division of the cord, the cutting off of the normal influence of the cerebellum or cerebrum, or a combination of these.

II.

About the slit-like cavity in the centre of the stem of gliomatosis there is a hard tissue, which is darker in color than that in the main portion of the tumor, and with moderate magnification it becomes evident that the deep color is due to the presence of particles, which, in unstained preparations, look yellow, while the background appears paler. A few of these particles are seen in many portions of the tumor, but by far the greater number are arranged about the cavity in the stem of gliomatosis. Certain of them are undoubtedly blood-vessels, but there is no question that many are not, for they are more refractive and much more irregular in shape, commonly showing a long body, very thin at one end and thicker at the other. They are usually of the shape of a pear or a screw. With a magnification of 500 diameters the tissue about the cavity is seen to be composed of cells and fibres embedded in a granular mass, resulting from precipitation of an albuminous fluid, the chief constituents of the tissue being spindle-shaped fibres, of varying length and breadth, with eccentric nuclei, the fibres being really the protoplasm of much elongated bipolar cells. There are great numbers of granules of very minute size up to 40 μ, which represent cross-sections of fibres of different thicknesses, which are much twisted and curved; the main portion of the mass is then a dense felt-work of cells and their prolongations. It is possible that some fibres are not processes of bipolar cells, but are glia-fibres (in Weigert's sense).

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[1] Deutsch. Zeitsch. f. Nervenheilkunde, 1894, Band vi., pp. 126-136.

[2] Archiv f. Physiatrie, vol. xxv. pp. 1 to 72.

The particles previously mentioned are found within the bodies of the cells, and consist of collections of waxy-looking material, apparently the result of degeneration of the protoplasm. Sometimes they are arranged in rows, as if they were the result of transformation of longitudinal fibres in the protoplasm. They are variable in shape and size, the large particles being more refractive and yellower than the smaller, and the latter seem to be an earlier stage of the degeneration. Sometimes they seem to occupy the whole of the cell.

Water has no effect upon them. They resist the action of cold nitric acid for a long time. They are more resistant to caustic potash than all the other elements of the tumor, but finally dissolve—much sooner than myelin, and, unlike myelin, they lose their lustre when acted upon by KOH. Lugol's solution stains them reddish-brown, a subsequent addition of 25 per cent. sulphuric acid causing little change. With the Weigert-Pal staining method (Plate III., Fig. 4) they appear black, the various arrangements which they may assume being seen in the figures. The illustrations also show the pale, refractive protoplasm of the cells and the very light areas that sometimes surround the particles. This degeneration is seen chiefly in cells about the cavity in the stem of gliomatosis, but also elsewhere in the tumor, and even on the white and gray matter of the cord outside of the tumor. There is no doubt that the fibres are portions of the protoplasm of bipolar cells, and in some areas the individual cells may be made out. Counter-staining by van Gieson's method after using the Weigert-Pal method leaves some of the masses stained with acid fuchsin, especially those toward the periphery of the cells. The particles hold acid fuchsin much longer than the rest of the tissue when differentiated with picric acid after using Altmann's aniline fuchsin. The same is true of van Gieson's stain used alone. If the differentiation in this method is pushed they become bright yellow. Iron-hæmatoxylin stains them slate-gray or blackish-gray.

Rosenthal has described a degeneration which, in general appearance and in staining reactions, closely resembles this; but there is the fundamental difference that he could trace no connection with the cells, while in Dr. Hudson's case the relation is clear. In some portions the glia-fibres show the degeneration, however, and the method of preservation precluded the use of Weigert's glia stain; and I believe that the two processes are identical. For simplicity in describing the condition I would suggest the term " Degeneratio micans," or, if preferred, " Rosenthal's degeneration," since he first described the specific staining reactions.

III.

The description of the tumor which I will give is intended to supplement that presented by Dr. Hudson. It will refer to (*a*) the cells composing it chiefly; (*b*) to the bloodvessels; (*c*) to the relation between the cells and vessels, and (*d*) to the cavities. The cells are not regularly arranged, but exist in masses, the smaller collections being about the bloodvessels. The cells are oval or nearly round; sometimes irregular or pyriform, and present one or more processes. They are separated by an intercellular substance consisting of delicate fibrils, the amount of the intercellular substance varying in different parts. The cells have an interesting relation to the bloodvessels. In one variety of appearance the vessels are enclosed by fibrils; in another by cells, though even in the latter a narrow line of fibrils exists between the cells and the vessel. When the cells are removed somewhat from the vessels the latter are surrounded by a radial arrangement of fibrils, which meet just at the vessel wall. These are undoubtedly continuous with the cells.

The bloodvessels are excessively numerous, and show much thickened, hyaline walls, and there is probably some calcareous infiltration; a peculiar feature is the persistence of the vasa vasorum even after entire occlusion of the lumen. The cavities are both pre-formed and softened. The pre-formed cavities are enclosed by a layer of fibres like that around the central canal of the cord, and upon this layer is a membrane lined with high epithelium. There have been hemorrhages into these cavities, and there is granular material at the edges which looks like degenerated neuroglia.

As to the softened cavities, none of the larger spaces can be said positively to be of this nature. There are, however, areas of disintegration which begin in the fibres, and about some vessels that appear to be veins there are collections of a granular, coagulated material.

There is no doubt that the pathological new formation is a tumor, and upon microscopical examination it becomes evident that it is a glioma.

The peculiar rosette-like arrangement of the cells about the bloodvessels has not been described previously in syringomyelia, but it has been seen in gliomata elsewhere, and I have recorded[1] an instance of grouping of the cells in such a form, though not necessarily about the bloodvessels. I have in the same paper described the production of glia-cells from ependyma-cells, and the cells composing this tumor are strikingly similar to embryonic ependymal cells, and are, I believe, of ependymal origin. Those lining the cavities are adult ependymal cells, and bear the same relation to the other cells of the tumor as do the cells lining the central canal of the cord to the neuroglia cells outside. The tumor is, therefore, what I have described as "ependymal-celled glioma."

Concerning the production of the cavities in syringomyelia, the most acceptable views are those of Hoffmann[2] and Schlesinger.[3] Both believe that there is in this condition a persistence of nests of embryonal tissue behind the central canal, perhaps in the line of closure. Hoffmann considers of equal etiological importance the existence of multiple spinal canals and the occurrence in the posterior commissure of large cells, the equivalents of ependyma-cells and their subsequent activity. Schlesinger agrees in the main, and adds that disease of vessels is equal in importance to the central gliosis. He insists that high central canal epithelium is frequently found as a lining to the cavities, and states that he considers hydromyelia and syringomyelia two forms of the same anatomical state. Saxer also attributes an important rôle to the central-canal epithelium in the production of pathological glia, though he does not think it is the essential source of the new tissue.

Schlesinger believes, however, that cavity formation may occur without primary increase in neuroglia. Müller and Meder[4] have reported a case, the increase of neuroglia in which they believed was secondary, and Weigert,[5] after citing cases, expresses his belief that the primary gliosis does not exist, and that the neuroglia may be even increased. He states that there is no proof that true gliosis softens, and there are many cases of extensive gliosis, as in multiple sclerosis, in which softening does not occur. Saxer[6] believes that softening in its various stages has been observed, and that many cases of syringomyelia have been encountered in which there was a primary increase in glia.

In this case beginning and advanced softening was observed in the pathological glia, and the extent and character of the new growth proves that it is of primary origin.

The question as to whether the new tissue in this case is to be considered a tumor must be answered affirmatively. It is an independent formation, and does not appear as the result of the action of any known irritant, it is circumscribed, and the cells composing it are embryonic.

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[1] Journal of Nervous and Mental Diseases, May, 1898.

[2] Deutsch. Zeitsch. f. Neurvenheilkunde, 1893, vol. iii.

[3] Die Syringomyelie. Vienna, 1895.

[4] Zeitsch. f. klin. med., Band xxviii.

[5] Beiträge z. Kenntniss d. Neuorolen menschlichen Neuroglia, 1895.

[6] Zeigler's Beiträge, Band xx.

DESCRIPTION OF PLATES.

PLATE I.

The drawing shows the position within the spinal cord of the new growth of glia and its extent; it also indicates the levels of the several sections and their chief characteristics. The letters E.C. indicate the epithelial cavities. T. is the tumor.

PLATE II.

FIG. 1 corresponds to Plate I., Section 1. Central growth of glia developed within the gray matter of the cord, chiefly within the posterior horns, which are entirely destroyed. Anterior horns partially preserved. *a* and *b*. Epithelial lined cavities. Weigert, Pal, and van Gieson's method. Magnified 6 times.

FIG. 2 corresponds to Plate I., Section 4. The new growth is somewhat more extensive, and, while occupying the entire posterior segment of the cord, it also encroaches upon the anterior white matter. The central zone shows rarefaction. *a b c*. Epithelial lined cavities. Magnified 6 times.

FIG. 3 corresponds with Plate I., Section 5. Except for the large number of epithelial-lined cavities, *a b c d e f*, it is similar to Fig. 2. Magnified 6 times.

PLATE III.

FIG. 1 corresponds with Plate I., Section 6. Two foci (stems) of tumor developed centrally in the cord, but posterior to the anterior commissure. The position of the central canal is indicated by *c*. In the larger focus an epithelial-lined cavity, in the smaller, a degenerative one, are shown. Magnified 6 times.

PLATE IV.

FIG. 1. Portion of Section 4, magnified 500 times. This drawing is from a softened area into which hemorrhage has taken place. It shows fragments of fibres, naked nuclei, and free red blood-corpuscles. There are independent cells and fibres, probably due to a degenerative process. Stained after Van Gieson's method.

FIG. 2. Portion of Plate I., Section 3, magnified 100 times. Projecting folds, resembling Grecian columns, covered with cylindrical epithelium, are shown. The folds are composed of rosettes of polyform cells, the similarity to ependyma cells being evident. Bloodvessels with much thickened walls and others with normal walls are present. The rosettes are developed about small bloodvessels. Stained in hæmatoxylin and eosin.

ADDITIONAL FIGURES.

Plate III., Fig. 2. Section through half of stem of new growth, showing part of cavity and distribution of the larger masses of glistening degeneration (Degeneratio micans). Müller's fluid, hardening, celloidin section unstained, mounted in salty glycerin, magnification of 10 diameters. The branch of the cavity marked *x* corresponds to the portion seen under higher power in Fig. 3.

Plate III., Fig. 3. Higher magnification of a part of the same preparation represented in Fig. 2.

c. Bloodvessels. The masses of the glistening substance assume various forms. A large number of pale swollen fibrils containing none of the refractive substance are indicated. Near the central cavity the coagulated albumin is seen. Magnification of 62 diameters (Zeiss, Compens. Oc. 4, Apochr. Obj.16 mm.).

Plate III., Fig. 4. Series of drawings representing elements selected from a Weigert-Pal preparation of the tissues pictured in Figs. 2 and 3; magnification of 500 diameters (Zeiss Compens. Oc. 4, Apochr. Obj. Oil imm. 2.0 mm.).

a. Parts of two swollen bipolar cells met with in one field of the microscope. These two cells do not contain the glistening substance. The nucleus is in both placed excentrically, this being obvious in the one cell seen "in profile."

b. Part of long bipolar cell in large part converted into the glistening substance, here stained black. At the thick extremity is a drop of protoplasm showing none of the Degeneratio micans.

c. Part of a swollen bipolar cell showing a black core with peripheral, nearly parallel, rows of dots and rods of the black substance.

d. Part of a bipolar cell showing rows of drops and rods, as well as several large drops of the blackened substance. A few very pale areas are visible in the protoplasm.

e. Part of bipolar cell showing central core of substance stained black, which at one end of the figure is resolved into a bundle of parallel rows of black dots and rods. There is a relatively large amount of swollen rather refractive protoplasm peripherally placed, which is free from Degeneratio micans.

f. A small bundle of interrupted black lines of the stained glistening substance embedded apparently in a common ground mass of protoplasm,

g. A complex of sections of fibres of various sizes running in different directions. Fusiform masses of the black substance distinctly visible in some of them.

h. Cross section of a rather large bipolar cell showing transverse sections of the longitudinal rows of masses of the blackened Degeneratio micans.

k. Large refractive mass containing particles of the blackened glistening substance. The protoplasm has apparently "run" into this form.

l, m. Sections of swollen bipolar cells containing sections of pale masses. Inside the latter are seen irregularly distributed droplets of the blackened glistening substance.

n. Two very fine fibres, both taken from a part in which all the elements in the tissue are swollen. One of the fibres is free from, the other contains, the substance which stains black in Weigert-Pal.

o. A rather fine fibre, showing fragments of the blackened substance. The upper thickened end of the fibre is seen in cross sections and on the cut surface is seen a central core, which consists of a homogeneous fused mass of the blackened glistening substance.

A CASE OF LYMPHATIC LEUKÆMIA COMBINED WITH PULMONARY TUBERCULOSIS.

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AND

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References to the combination of leukæmia with tuberculosis are not common in the literature of either disease in a careful review that we have made of the subject. Moreover, the distinctly lymphatic variety of leukæmia alone is uncommon, as well as the slow course apparently run by this case whose history of the enlarged lymph-nodes covers nearly two years.

Volpe[30] reports two cases and reviews six from previous records. Cases are described by Quincke and Stintzing, which are mentioned by Lichtheim,[1] who also had one of the splenic-myelogenous variety, terminating with acute tuberculosis. Musser[2] and Sailer found a healed tuberculous focus in the lungs of a leukæmic individual. A case of splenic-myelogenous type by Weidner[3] may have been tuberculous also.

What the influence of each disease upon the other may have been in our case is not easily determined. The two diseases seemed to have periods of activity and quiescence, with the leukæmia most prominent at the time of death, but we cannot say what their relations were except from the history, until three months prior to death. It may, indeed, have been an instance of pseudo-leukæmia gradually transformed into